Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2017-522-AC1, 2018

Biogeosciences
Discussions
Open Access

Interactive comment on "Contributions of the direct supply of belowground seagrass detritus and trapping of suspended organic matter to the sedimentary organic carbon stock in seagrass meadows" *by* Toko Tanaya et al.

Toko Tanaya et al.

tanaya-t@ipc.pari.go.jp

Received and published: 7 April 2018

General comments

Comment #1: The paper was well executed and written and presented novel data on seagrass carbon dynamics. Particularly, this paper fills in a much needed gap on tropical blue carbon ecosystems and the contribution of belowground biomass (esp. sheathes) to carbon stocks, the latter often erroneously overlook or lumped in as the sediment carbon stock. It would be interesting to expand on this study by looking at similar variables at deeper depths so that (a) it is comparable to global studies that look at 30-100 cm depths, and (b) we can understand better the long-term contributions of seagrass and allochthonous OC were living biomass isn't present and detritus has been processed more by microbial remineralization. There are some concerns about the lumping of different vegetation types into a site average, but otherwise these are minor revisions.

Reply #1: Thank you for your helpful comments. Please see our Reply #12 to your main concern.

Specific comments

Abstract

Comment #2: Lines 3, 11, 13: What is meant by enrichment? Looking at the next sentences, 'accumulation' may be a more accurate term. Change throughout the manuscript.

Reply #2: Concur.

Change #2: We have changed the term as per your suggestion.

Comment #3: Line 5: 'bodies' is an uncommon term for seagrasses and should be 'plants' or 'biomass' here and throughout the manuscript.

Reply #3: Concur.

Change #3: We have deleted 'bodies' or changed it to 'plants' or 'biomass' as per your suggestion.

Comment #4: It will be helpful to describe what species of seagrass are being studied in the abstract.

Reply #4: Concur.

Change #4: We have added "Thalassia hemprichii dominated" before "back-reef" and

Printer-friendly version

Discussion paper

"Enhalus acoroides dominated" before "estuarine sites" (page 2, line 7).

Comment #5: Line 16: no need to hyphenate blue carbon. Change throughout the manuscript as well.

Reply #5: Concur.

Change #5: We have removed the hyphen as per your suggestion.

Introduction

Comment #6: Lines 17-30: Consider Trevathan-Tackett et al. 2017 as a specific review of seagrass recalcitrance and the potential for contributing to OC stocks (doi: 10.3389/fpls.2017.00925); it will also be useful in the first section of the discussion. Also consider new research on providence of OC in seagrass meadows using eDNA: Reef et al 2017 doi: 10.1002/lno.10499

Reply #6: Concur with Trevathan-Tackett et al. 2017. However, we did not cite Reef et al. 2017 because our focus is not on the detailed provenance of OC but on factors controlling OC.

Change #6: We have added "; Trevathan-Tackett et al., 2017" to page 3 line 17.

Methods

Comment #7: How are you considering leaf detritus in these sediment measurements/ calculations? In sections 2.2 it says it's a part of the dead plant structures but not in the calculations. Is it assumed that 100% of the surface leaf detritus is exported and not buried?

Reply #7: Leaf detritus is included in the OC mass calculation (page 7 line 23 and lines 27–30) but not in the calculation of δ13Csed (page 8 line 3). We have added the reason for its exclusion from the latter after the explanation of the calculation of δ13Csed.

Change #7: We have added the following sentences (page 8 line 4): "We did not include leaf detritus in the calculation of δ13Csed because (1) the leaf fragments were so small that we could not remove epiphytes from them, and (2) their mass was much smaller than that of the sheath and rhizomes and roots, so we considered its contribution to δ13Csed to be negligible."

Comment #8: Why is the Cfsed calculation multiplied by 1/3 (eqs. 6 & 8)?

Reply #8: We have multiplied by 1/3 because OCfsed is the averaged OC mass of the three layers (surface, medium, and bottom) of fine sediment.

Change #8: We have added the following sentence (page 7 line 30): "OCfsed is the averaged OC mass of the three layers (surface, medium, and bottom) of fine sediment".

Comment #9: How do equations 7 and 8 relation to traditional mixing model methods to look at OC providence? Were the end-members (seagrass, POM, algae/coral, terrestrial) taken into account? It seems a waste not to use this stable isotope to quantitatively obtain OC contribution values.

Reply #9: We intentionally did not use the stable isotope mixing model because, in the case examined in the present study, it failed to reliably isolate the contribution of seagrass from those of algae and corals; rather, the strong negative correlations among the inferred values imply that one source is simply being traded off against the other. (see Parnell et al., 2010). We showed that the direct supply of belowground seagrass detritus was a major mechanism of OCsed accumulation at the back-reef site from the contribution of belowground detritus to OCdead and δ13Csed, and from the relationships among δ13Csed, biomass, OCsed and OCdead (pages 11 lines 23–30).

Reference

Parnell, A. C., Inger, R., Bearhop, S., & Jackson, A. L.: Source partitioning using stable isotopes: coping with too much variation, PLOS ONE, 5, e9672, 2010, doi: 10.1371/journal.pone.0009672.

Results

Comment #10: Since section 3.2 only has one sentence, I'd suggest adding it to the next OC section.

Reply #10: Concur.

Change #10: We have added the sentence in section 3.2 to the next section and renumbered all sections in the Results.

Comment #11: One suggestion is to make a supplementary table(s) for the statistics. This would make reading the text easier.

Reply #11: We do not concur. We have left the statistics in the main text for the convenience of readers who wish to use the statistics to help them understand the results.

Comment #12: Where are the data on the differences between vegetated, unvegetated and bare OC stocks and fractions? This will be very important in the interpretation of OCbio and OCdead. This will give better resolution into the differences within and between back-reef and estuary regions.

Reply #12: Concur.

Change #12: As per your suggestion, we have added a figure showing the differences in total OC stock and its components between vegetated and no-vegetation (unvegetated and bare area) points (Fig. AC1). At both sites, OCbio, OCdead, OCfsed, OCsed, and OCtotal were significantly higher at points with vegetation than at points without vegetation. At points with vegetation, OCbio, OCcsed and OCtotal were significantly higher at the estuarine site than at the back-reef site, whereas OCdead, OCfsed, OCsed were not different between the sites. Therefore, this revision further supports our conclusion described in the original manuscript (page 12 line 24). Figure AC1 replaces Figure 4 in the revised manuscript (page 27) and the figure caption (page 22 lines 12–14) as well as the relevant results (page 9 lines 2–11) and discussion (page 12 line 24) have been modified accordingly.

Comment #13: What about correlations between living AG:BG?

Reply #13: We concur that the relationship between living AG:BG should be added.

Change #13: We have added a description of the relationship in the manuscript (page 10 line 7): "We also found significant positive correlations between aboveground and belowground biomass ($F_{1,18} = 94.10$, $P < 0.001$, $r^2 = 0.84$)". We added the following sentence after "(Fig. 7c)." (page 10 line 12): "We also found significant positive correlations between aboveground and belowground biomass ($F_{1,6} = 78.40$, $P < 0.001$, $r^2 = 0.93$)".

Discussion

Comment #14: Page 10, Lines 17-19: NO, we cannot assume constant to 1-m depth. There are important processes that affect OC down core, most notably the reduction on living biomass with depth, change in bulk density and microbial remineralization, so there is absolutely no meaning to the OCbio to OCtotal estimate. Please remove this sentence and calculation and find another more robust way to compare the OCbio data to previous literature.

Reply #14: We deleted the sentence as per your suggestion. Instead, we compared OCbio and OCtotal in this study with the above + belowground seagrass biomass OC and sedimentary OC in the top 0.15-m-thick layer, respectively, reported in a previous study (Fourqurean et al., 2012) (Table AC1).

Change #14: We have deleted the sentence (page 10 lines 17–21): "If we assume... (Fourqurean et al., 2012)". Instead, we compared data of OCbio and OCtotal in the present study with Fourqurean et al. (2012)'s data in the top 0.15-m-thick layer. We have added a new table (Table AC1) and the following sentence: "The averaged OCbio was significantly higher in this study than that in the previous study by Fourqurean et al. (2012) ($W = 1691$, $P = 0.006$), whereas the averaged OCsed was significantly lower in this study than in the previous study at both vegetated and no-vegetation points (vegetated, W = 6952, $P < 0.001$; no-vegetation, W = 225, P = 0.039) (Table AC1). Hence, the contribution of OCbio to OCtotal at our sites was higher than the global average". We also changed "the highest in globally compiled data" to "higher than in globally compiled data" in the abstract (page 2 line 8).

Comment #15: Second paragraph: Anoxic sediments that generally reduce decomposition rates also can lead to higher preservation of OC.

Reply #15: True, but we did not add a statement about this effect to the main text because we were addressing the differences in the characteristics of OC accumulation in sediment between aboveground and belowground seagrass detritus.

Figures

Comment #16: Figure 1 is low quality and fuzzy and thus hard to read Figure 3: please define the abbreviations in the caption.

Reply #16: Concur.

Change #16: We have replaced Figure 1 with Figure AC2. We have defined the abbreviations in the caption of Figure 3.

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2017-522, 2017.

Table AC1. Values of seagrass biomass organic carbon and sedimentary organic carbon mass in globally compiled data (Fourqurean *et al.*, 2012) and this study (mean ± SD, *n*).

	Vegetated		No-vegetation	
	Seagrass biomass OC (gC m^{-2})	Sedimentary OC (gC L^{-1})	Seagrass biomass OC (gC m^{-2})	Sedimentary OC (gC L^{-1})
	mean ± SD (*n*)	mean ± SD (*n*)	mean ± SD (*n*)	mean ± SD (*n*)
Fourqurean *et al.*, 2012	251.4 ± 395.6 (251)	12.32 ± 8.04 (410)	-	8.08 ± 5.90 (43)
This study	283.0 ± 200.8 (21)	5.03 ± 1.32 (21)	-	2.93 ± 0.73 (7)

11

Fig. 1. Table AC1

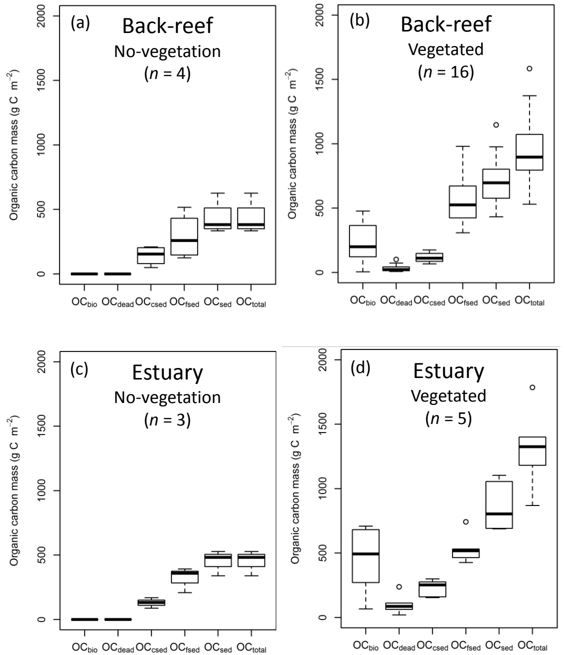

Figure AC1 : OC mass (OC_{bio}, OC_{dead}, OC_{csed}, OC_{fsed}, OC_{sed}, and OC_{total}) at (a) no-vegetation (bare and unvegetated) points at the back-reef site, (b) vegetated points at the back-reef site, (c) no-vegetation points at the estuarine site, and (d) vegetated points at the estuarine site. Boxes show the 25% and 75% quantiles; horizontal bands inside the boxes are median values; whiskers show maximum and minimum values; and the open circles are outliers.

Fig. 2. Figure AC1

Printer-friendly version

Discussion paper

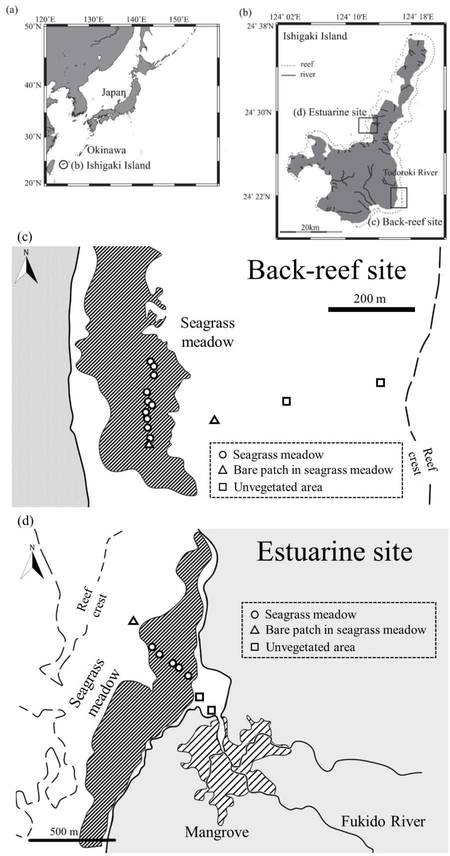

Figure AC2: (a) (b) Study site location on Ishigaki Island, Japan. Sampling points at the (c) back-reef and (d) estuarine sites. At the back-reef site, the circle indicating the southernmost vegetated sampling point actually represents a cluster of six sampling points.

Fig. 3. Figure AC2

Printer-friendly version

Discussion paper